

Listing of Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (previously presented): A thermal interface material for bonding components of electronic devices, the thermal interface material comprising:

a solder component comprising a bonding component selected from the group consisting of In, Sn, Cu, Pb, Sb, Au, Ag, alloys thereof, Bi alloys, and mixtures thereof; and

an additive component comprising an uncoated CTE modifying component having a coefficient of thermal expansion that is less than about 10  $\mu\text{m}/\text{m}^\circ\text{C}$ .

Claim 2 (original): The thermal interface material of claim 1 further comprising an intrinsic oxygen getter selected from the group consisting of rare earth metals, alkali metals, alkaline-earth metals, refractory metals, Zn, and mixtures and alloys thereof.

Claim 3 (original): The thermal interface material of claim 1 further comprising an intrinsic oxygen getter selected from the group consisting of Li, Na, K, Mg, Ca, Ti, Zr, Hf, Ta, V, Nb, La, Ce, Pr, Sm, Nd, Eu, Gd, Tb, Dy, Yb, and mixtures and alloys thereof.

Claim 4 (previously presented): The thermal interface material of claim 1 wherein the additive component further comprises a thermal conductivity enhancement component selected from the group consisting of Al, Ag, Cu, Al-coated Cu, Au, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, carbon phases, and mixtures thereof.

Claim 5 (original): The thermal interface material of claim 1 comprising, as the bonding component, Au and a second metal selected from the group consisting of Sn, Si, Ge, and mixtures and alloys thereof.

Claim 6 (original): The thermal interface material of claim 1 wherein the solder component wets metallic and non-metallic surfaces without extrinsic fluxing, the solder component comprising a bonding component selected from the group consisting of In and In-Sn alloys, and further comprising an intrinsic oxygen getter selected from the group consisting of alkali metals, alkaline-earth metals, refractory metals, rare earth metals, Zn, and mixtures and alloys thereof.

Claim 7 (canceled)

Claim 8 (original): The thermal interface material of claim 1 comprising a multilayer solder preform structure wherein the solder component constitutes a first layer comprising the bonding component filled with the additive component, and wherein the first layer is interposed between a second layer and a third layer, wherein the second and third layers comprise solder metal selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, Bi alloys, and mixtures thereof.

Claim 9 (original): The thermal interface material of claim 8 wherein the first layer has a thickness between about 0.001 inch(0.025 mm) and about 0.125 inch (3 mm), and second and third layers each have a thickness between about 0.0001 inch (0.0025 mm) and about 0.02 inch (0.5 mm).

Claim 10 (original): The thermal interface material of claim 1 comprising a spherical solder preform comprising a sphere body and a sphere body surface layer, wherein the sphere body comprises the bonding component filled with the additive component, and wherein the sphere body surface layer comprises a layer of unfilled solder metal selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, Bi alloys, and mixtures thereof.

Claim 11 (original): The thermal interface material of claim 10 wherein the sphere body has a diameter of between about 0.003 inch (0.075 mm) and about 0.06 inch (1.5 mm), and the sphere body surface layer has a thickness between about 0.0005 inch (0.0125 mm) and about 0.05 inch (1.25 mm).

Claim 12 (previously presented): A thermal interface material for bonding components of electronic devices, the thermal interface material comprising:

a solder component comprising a bonding component selected from the group consisting of In, Cu, Au, Sn, Pb, Sb, Ag, alloys thereof, Bi alloys, and mixtures thereof;

an additive component comprising a CTE modifying component having a coefficient of thermal expansion that is less than about 10  $\mu\text{m}/\text{m}^\circ\text{C}$ ; and

an intrinsic oxygen getter selected from the group consisting of rare earth metals, alkali metals, alkaline-earth metals, refractory metals, Zn, and mixtures and alloys thereof.

Claim 13 (canceled)

Claim 14 (original): The thermal interface material of claim 12 comprising a multilayer solder preform structure

wherein the solder component constitutes a first layer comprising the bonding component filled with the additive component, and wherein the first layer is interposed between a second layer and a third layer, wherein the second and third layers comprise solder metal selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof.

Claim 15 (original): The thermal interface material of claim 14 wherein the first layer has a thickness between about 0.001 inch (0.025 mm) and about 0.125 inch (3 mm), and second and third layers each have a thickness between about 0.0001 inch (0.0025 mm) and about 0.02 inch (0.5 mm).

Claim 16 (original): The thermal interface material of claim 12 comprising a spherical solder preform comprising a sphere body and a sphere body surface layer, wherein the sphere body comprises the bonding component filled with the additive component, and wherein the sphere body surface layer comprises a layer of unfilled solder selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof.

Claim 17 (original): The thermal interface material of claim 16 wherein the sphere body has a diameter of between about 0.003 inch (0.075 mm) and about 0.06 inch (1.5 mm), and the sphere body surface layer has a thickness between about 0.0005 inch (0.0125 mm) and about 0.05 inch (1.25 mm).

Claim 18 (previously presented): An active solder that wets metallic and non-metallic surfaces without extrinsic fluxing, the active solder comprising a bonding component

selected from the group consisting of In, Cu, Au, Sn, Pb, Sb, Ag, alloys thereof, Bi alloys, and mixtures thereof, an intrinsic oxygen getter selected from the group consisting of rare earth metals, alkali metals, alkaline-earth metals, refractory metals, Zn, alloys thereof, and mixtures thereof, and an additive component comprising a CTE modifying component having a coefficient of thermal expansion that is less than about 10  $\mu\text{m}/\text{m}^\circ\text{C}$ .

Claim 19 (previously presented): An active solder that wets metallic and non-metallic surfaces without extrinsic fluxing, the active solder comprising a bismuth alloy bonding component, an intrinsic oxygen getter selected from the group consisting of rare earth metals, alkali metals, alkaline-earth metals, refractory metals, Zn, alloys thereof, and mixtures thereof, and an additive component comprising a CTE modifying component having a coefficient of thermal expansion that is less than about 10  $\mu\text{m}/\text{m}^\circ\text{C}$ .

Claim 20 (currently amended): A multilayer solder preform for bonding components of electronic devices comprising:

a first solder preform layer having a top surface and a bottom surface and comprising a solder metal bonding component and into which is admixed an additive selected from among thermal conductivity enhancement components, CTE modifying components, and mixtures thereof;

a second solder metal preform layer comprising applied to the bottom surface of the first solder preform layer; and

a third solder metal preform layer applied to the top surface of the first solder preform layer.

Claim 21 (currently amended) : ~~The multilayer solder preform of claim 20~~ A multilayer solder preform for bonding components of electronic devices comprising:

a first solder preform layer having a top surface and a bottom surface and comprising a solder metal bonding component and an additive selected from among thermal conductivity enhancement components, CTE modifying components, and mixtures thereof;

a second solder metal preform layer comprising applied to the bottom surface of the first solder preform layer; and

a third solder metal preform layer applied to the top surface of the first solder preform layer, wherein the solder metal bonding component, the second solder metal preform layer, and the third solder metal preform layer are selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof.

Claim 22 (original) : The multilayer solder preform of claim 21 wherein the additive comprises a thermal conductivity enhancement component selected from among Al, Al-coated Cu, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases.

Claim 23 (original) : The multilayer solder preform of claim 21 wherein the additive comprises a thermal conductivity enhancement component which is uncoated and is selected from among Al, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases.

Claim 24 (original) : The multilayer solder preform of claim 21 wherein the additive comprises a CTE modifying component selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN,

SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders and mixtures thereof.

Claim 25 (previously presented): The solder preform of claim 21 wherein the additive comprises a CTE modifying component which is uncoated and is selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders, and mixtures thereof.

Claim 26 (original): The solder preform of claim 20 wherein the solder metal bonding component, the second solder metal preform layer, and the third solder metal preform layer are selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof; wherein the additive comprises a thermal conductivity enhancement component selected from among Al, Al-coated Cu, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases; and wherein the additive comprises a CTE modifying component selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders and mixtures thereof.

Claim 27 (previously presented): The solder preform of claim 20 wherein the solder metal bonding component, the second solder metal preform layer, and the third solder metal preform layer are selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof; wherein the additive comprises a thermal conductivity enhancement component which is uncoated and is selected from among Al, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high

conductivity cermets, cuprates, silicides, and carbon phases; and wherein the additive comprises a CTE modifying component which is uncoated and is selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders, and mixtures thereof.

Claim 28 (original): The multilayer solder preform of claim 20 wherein the first solder preform layer further comprises an intrinsic oxygen getter selected from the group consisting of rare earth metals, alkali metals, alkaline-earth metals, refractory metals, Zn, mixtures thereof, and alloys thereof.

Claim 29 (original): The multilayer solder preform of claim 20 wherein the first layer has a thickness between about 0.001 inch (0.025 mm) and about 0.125 inch (3 mm), and the second and third layers each have a thickness between about 0.0001 inch (0.0025 mm) and about 0.02 inch (0.5 mm).

Claim 30 (original): The multilayer solder preform of claim 22 wherein the first layer has a thickness between about 0.001 inch (0.025 mm) and about 0.125 inch (3 mm), and the second and third layers each have a thickness between about 0.0001 inch (0.0025 mm) and about 0.02 inch (0.5 mm).

Claim 31 (original): The multilayer solder preform of claim 24 wherein the first layer has a thickness between about 0.001 inch (0.025 mm) and about 0.125 inch (3 mm), and the second and third layers each have a thickness between about 0.0001 inch (0.0025 mm) and about 0.02 inch (0.5 mm).

Claim 32 (currently amended): A solder preform for bonding components of electronic devices comprising:

a sphere body comprising a sphere body solder metal bonding component and into which is admixed an additive component selected from among thermal conductivity enhancement components, CTE modifying components, and mixtures thereof; and

a sphere body surface layer comprising a solder metal over the sphere body.

Claim 33 (original): The solder preform of claim 32 wherein the sphere body solder metal bonding component and the sphere body surface layer are selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, and Bi alloys.

Claim 34 (original): The solder preform of claim 32 wherein the additive comprises a thermal conductivity enhancement component selected from among Al, Al-coated Cu, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases.

Claim 35 (original): The solder preform of claim 32 wherein the additive comprises a thermal conductivity enhancement component which is uncoated and is selected from among Al, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases.

Claim 36 (original): The solder preform of claim 32 wherein the additive comprises a CTE modifying component selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders and mixtures thereof.

Claim 37 (previously presented): The solder preform of claim 32 wherein the additive comprises a CTE modifying component which is uncoated and is selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders, and mixtures thereof.

Claim 38 (original): The solder preform of claim 32 wherein the sphere body solder metal bonding component and the sphere body surface layer are selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof; wherein the additive comprises a thermal conductivity enhancement component selected from among Al, Al-coated Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases; and wherein the additive comprises a CTE modifying component selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-Ni alloys, low expansion ceramic powders, low expansion glass powders and mixtures thereof.

Claim 39 (original): The solder preform of claim 32 wherein the sphere body solder metal bonding component and the sphere body surface layer are selected from the group consisting of Sn, Cu, In, Pb, Sb, Au, Ag, alloys thereof, a Bi alloy, and mixtures thereof; wherein the additive comprises a thermal conductivity enhancement component which is uncoated and is selected from among Al, Cu, Ag, Au, and alloys thereof, AlN, BeO, BN, high conductivity cermets, cuprates, silicides, and carbon phases; and wherein the additive comprises a CTE modifying component which is uncoated and is selected from the group consisting of BeO, Al<sub>2</sub>O<sub>3</sub>, AlN, SiC, SiO<sub>2</sub>, low expansion Fe-

Ni alloys, low expansion ceramic powders, low expansion glass powders and mixtures thereof.

Claim 40 (original): The solder preform of claim 32 wherein the sphere body further comprises an intrinsic oxygen getter selected from the group consisting of rare earth metals, alkali metals, alkaline-earth metals, refractory metals, Zn, mixtures thereof, and alloys thereof.

Claim 41 (original): The solder preform of claim 32 wherein the sphere body has a diameter of between about 0.003 inch (0.075 mm) and about 0.06 inch (1.5 mm), and the sphere body surface layer has a thickness between about 0.0005 inch (0.0125 mm) and about 0.05 inch (1.25 mm).

Claim 42 (original): The solder preform of claim 35 wherein the sphere body has a diameter of between about 0.003 inch (0.075 mm) and about 0.06 inch (1.5 mm), and the sphere body surface layer has a thickness between about 0.0005 inch (0.0125 mm) and about 0.05 inch (1.25 mm).

Claim 43 (original): The solder preform of claim 36 wherein the sphere body has a diameter of between about 0.003 inch (0.075 mm) and about 0.06 inch (1.5 mm), and the sphere body surface layer has a thickness between about 0.0005 inch (0.0125 mm) and about 0.05 inch (1.25 mm).

Claim 44 (previously presented): The thermal interface material of claim 1 wherein the CTE modifying component is selected from the group consisting of beryllium oxide, aluminum oxide, aluminum nitride, silicon carbide, silicon dioxide, low

expansion iron-nickel alloys, low expansion ceramic powders, low expansion glass powders, and mixtures thereof.

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Claim 45 (previously presented): The thermal interface material of claim 12 wherein the additive component further comprises a thermal conductivity enhancement component having a thermal conductivity that is at least about 100 W/mK.